UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Science
BACHELOR OF SCIENCE IN ENVIRONMENTAL HEALTH

RE-SIT EXAMINATION PAPER 2017

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TITLE OF PAPER	:	CHEMISTRY FOR HEALTH SCIENCES
COURSE CODE	:	EHS 111
DURATION	:	2 HOURS
MARKS	:	100
INSTRUCTIONS	:	READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
	:	ANSWER **ANY FOUR** QUESTIONS
	:	EACH QUESTION **CARRIES 25** MARKS.
	:	WRITE NEATLY & CLEARLY
	:	NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE EXAMINATION ROOM.
	:	BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER.

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR.

QUESTION ONE

a. Balance the following redox reaction equations in both acidic and basic media. Also identify the reducing and oxidizing agent in the reaction

$$MnO_4^- + Br^- \rightarrow Mn^{2+} + Br_2 \qquad \textbf{[20 Marks]}$$
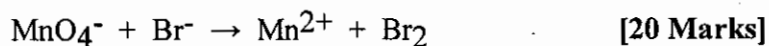
b. The molecular formula of aspartame, an artificial sweetener, is $C_{14}H_{18}N_2O_5$. Calculate the mass of carbon atoms that are present in 1.00 mg of aspartame.

[5 Marks]

QUESTION TWO

a. The empirical formula of a compound containing phosphorous and oxygen was found to be P_2O_5. If the molar mass is determined to be 283.9 g/mol, what is the molecular formula? **[8 Marks]**

b. If 0.575 mole of CO_2 is produced by the combustion of propane, C_3H_8, how many moles of oxygen are consumed? **[8 Marks]**

c. Draw the Lewis structures for the following compounds:
   (i)   OCl-
   (ii) PH_3
   (iii) HNO_3 **[9 Marks]**

QUESTION THREE

a. Use the electronegativity table to determine whether the following compounds are ionic or covalent (pure or polar) compounds. Provide a reason for each answer.
   (i) H_2O_2
   (ii) KBr
   (iii)$CuCl_2$
   (iv)TiO_2 **[8 Marks]**

b. If 18.1 g NH_3 is reacted with 90.4 g CuO, what is the maximum amount of Cu metal that can be formed? The balanced chemical equation is given below.

$$2NH_3(g) + 3CuO(s) \rightarrow N_2(g) + 3Cu(s) + 3H_2O(g)$$
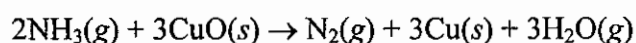
[8 Marks]

c. Naturally occurring magnesium is a mixture of 3 isotopes; 78.99% of the atoms are ^{24}Mg (atomic mass, 23.9850 u), 10.00% of ^{25}Mg (atomic mass, 24.9858 u), and 11.01% of ^{26}Mg (atomic mass, 25.9826 u). From these data calculate the average atomic mass of magnesium. **[9 Marks]**

QUESTION FOUR

a. Give the charge and electron configuration on the ion which is underlined in the following compounds:

(i) $\underline{Sn}(NO_3)_2$

(ii) $\underline{Ba}Cl_2$
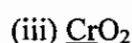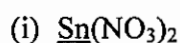
(iii) $\underline{Cr}O_2$ **[15 Marks]**

b. The K_a of hypochlorous acid (HClO) is 3.0×10^{-8} at 25.0°C. What is the % ionization of hypochlorous acid in a 0.015 M aqueous solution of HClO at 25.0°C? **[6 Marks]**

c. In the process of attempting to characterize a substance, a chemist makes the following observations:-

The substance is a silvery white, lustrous metal. It melts at 649°C and boils at 1105°C. The substance burns in air, producing an intense white light. It reacts with chlorine to give a brittle white solid. The substance can be pounded into thin sheets or drawn into wires. It is a good conductor of electricity.

Identify any two chemical and two physical properties of the unknown substance. **[4 Marks]**

QUESTION FIVE

a. Complete the following statements;

(i) The three subatomic particles are _____, _____ and _____.

(ii) Polar covalent bond has bond polarity of_____.

(iii) Solids and liquids share the property of_____.

(iv) A common English set of units for expressing speed are miles/hour. The SI unit for speed is _____ .

(v) An atom of the most common isotope of gold, ^{197}Au, has _____ protons, _____ neutrons, and _____ electrons

(vi) The elements in groups 1A, 3-8B, and 7A are called, _____, _____ and _____ , respectively.

(vii) A reducing reagent is _____ .

(viii) Units for specific gravity are _____

(ix) Aluminium reacts with a certain non-metallic element to form a compound with the general formula Al_2X_3. Element X must be from Group _____ of the Periodic Table of Elements.

(x) The oxidation number of Cl in $NaClO_4$ is _____ .

[20 Marks]

b. What is the difference between a physical and a chemical change?

[2 Marks]

c. State the first law of thermodynamics. **[3 Marks]**
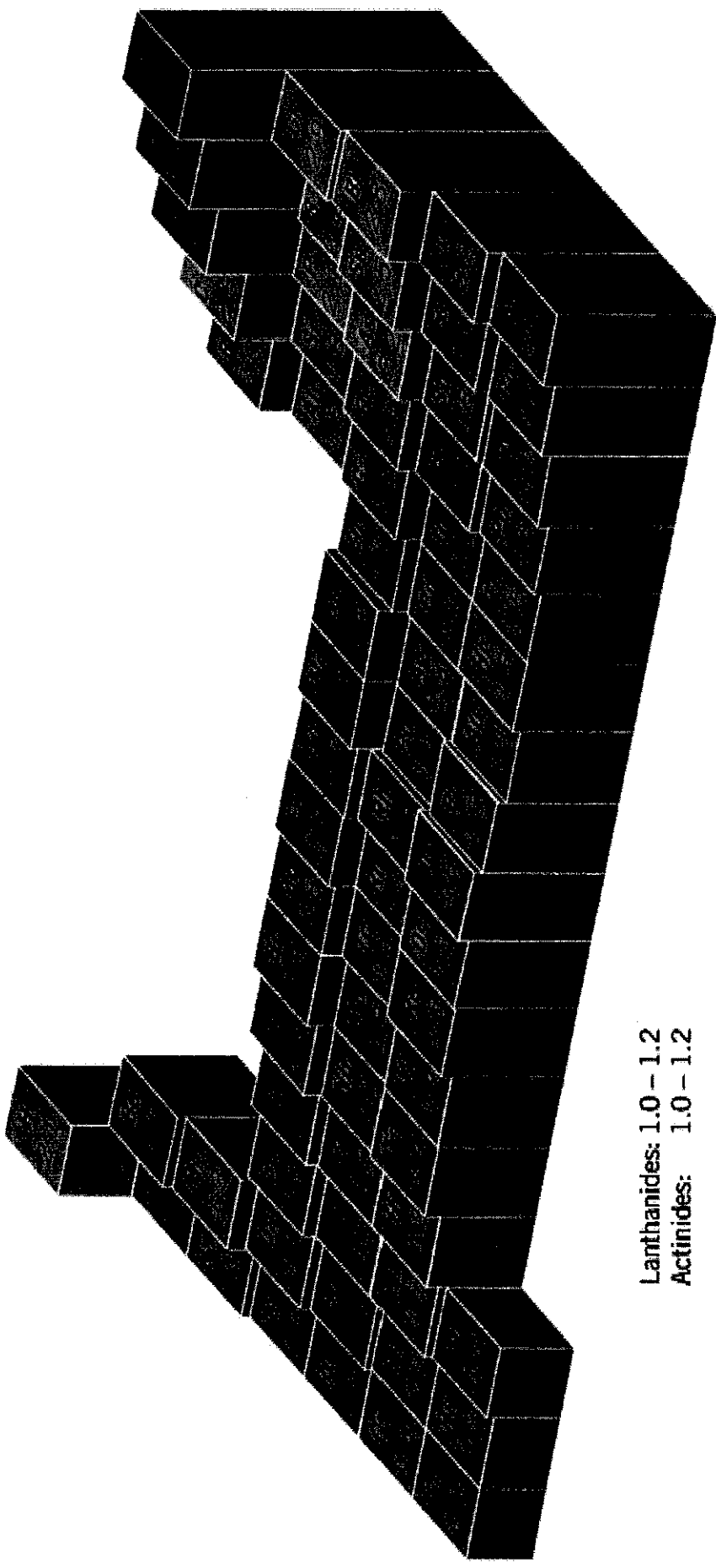
General data and fundamental constants

Quantity	Symbol	Value
Speed of light	c	$2.997\ 924\ 58 \times 10^8$ m s^{-1}
Elementary charge	e	$1.602\ 177 \times 10^{-19}$ C
Faraday constant	$F = N_A e$	9.6485×10^4 C mol^{-1}
Boltzmann constant	k	$1.380\ 66 \times 10^{-23}$ J K^{-1}
Gas constant	$R = N_A k$	$8.314\ 51$ J K^{-1} mol^{-1}
		$8.205\ 78 \times 10^{-2}$ dm^3 atm K^{-1} mol^{-1}
		6.2364×10 L Torr K^{-1} mol^{-1}
Planck constant	h	$6.626\ 08 \times 10^{-34}$ J s
	$\hbar = h/2\pi$	$1.054\ 57 \times 10^{-34}$ J s
Avogadro constant	N_A	$6.022\ 14 \times 10^{23}$ mol^{-1}
Atomic mass unit	u	$1.660\ 54 \times 10^{-27}$ Kg
Mass		
electron	m_e	$9.109\ 39 \times 10^{-31}$ Kg
proton	m_p	$1.672\ 62 \times 10^{-27}$ Kg
neutron	m_n	$1.674\ 93 \times 10^{-27}$ Kg
Vacuum permittivity	$\varepsilon_0 = 1/c^2\mu_0$	$8.854\ 19 \times 10^{-12}$ J^{-1} C^2 m^{-1}
	$4\pi\varepsilon_0$	$1.112\ 65 \times 10^{-10}$ J^{-1} C^2 m^{-1}
Vacuum permeability	μ_0	$4\pi \times 10^{-7}$ J s^2 C^{-2} m^{-1}
		$4\pi \times 10^{-7}$ T^2 J^{-1} m^3
Magneton		
Bohr	$\mu_B = e\hbar/2m_e$	$9.274\ 02 \times 10^{-24}$ J T^{-1}
nuclear	$\mu_N = e\hbar/2m_p$	$5.050\ 79 \times 10^{-27}$ J T^{-1}
g value	ge	$2.002\ 32$
Bohr radius	$a_0 = 4\pi\varepsilon_0\hbar/m_e e^2$	$5.291\ 77 \times 10^{-11}$ m
Fine-structure constant	$\alpha = \mu_0 e^2 c/2h$	$7.297\ 35 \times 10^{-3}$
Rydberg constant	$R_\infty = m_e e^4/8h^3 c\varepsilon_0^2$	$1.097\ 37 \times 10^7$ m^{-1}
Standard acceleration of free fall	g	$9.806\ 65$ m s^{-2}
Gravitational constant	G	$6.672\ 59 \times 10^{-11}$ N m^2 Kg^{-2}

Conversion factors

1 cal	=	4.184 joules (J)	1 erg	=	1×10^{-7} J
1 eV	=	$1.602\ 2 \times 10^{-19}$ J	1 eV/molecule	=	96 485 kJ mol^{-1}

Prefixes

f	p	n	μ	m	c	d	k	M	G
femto	pico	nano	micro	milli	centi	deci	kilo	mega	giga
10^{-15}	10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{-1}	10^3	10^6	10^9

Electronegativity Table

Lanthanides: 1.0 – 1.2
Actinides: 1.0 – 1.2

Brady/Jespersen/Hyslop   Chemistry: The Molecular Nature of Matter, 6E

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PERIODIC TABLE OF ELEMENTS

GROUPS

Legend: Atomic mass → / Symbol → / Atomic No. →

PERIODS	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1.008 H 1																	4.003 He 2
2	6.941 Li 3	9.012 Be 4											10.811 B 5	12.011 C 6	14.007 N 7	15.999 O 8	18.998 F 9	20.180 Ne 10
3	22.990 Na 11	24.305 Mg 12											26.982 Al 13	28.086 Si 14	30.974 P 15	32.06 S 16	35.453 Cl 17	39.948 Ar 18
4	39.098 K 19	40.078 Ca 20	44.956 Sc 21	47.88 Ti 22	50.942 V 23	51.996 Cr 24	54.938 Mn 25	55.847 Fe 26	58.933 Co 27	58.69 Ni 28	63.546 Cu 29	65.39 Zn 30	69.723 Ga 31	72.61 Ge 32	74.922 As 33	78.96 Se 34	79.904 Br 35	83.80 Kr 36
5	85.468 Rb 37	87.62 Sr 38	88.906 Y 39	91.224 Zr 40	92.906 Nb 41	95.94 Mo 42	98.907 Tc 43	101.07 Ru 44	102.91 Rh 45	106.42 Pd 46	107.87 Ag 47	112.41 Cd 48	114.82 In 49	118.71 Sn 50	121.75 Sb 51	127.60 Te 52	126.90 I 53	131.29 Xe 54
6	132.91 Cs 55	137.33 Ba 56	138.91 *La 57	178.49 Hf 72	180.95 Ta 73	183.85 W 74	186.21 Re 75	190.2 Os 76	192.22 Ir 77	195.08 Pt 78	196.97 Au 79	200.59 Hg 80	204.38 Tl 81	207.2 Pb 82	208.98 Bi 83	(209) Po 84	(210) At 85	(222) Rn 86
7	223 Fr 87	226.03 Ra 88	(227) **Ac 89	(261) Rf 104	(262) Ha 105	(263) Unh 106	(262) Uns 107	(265) Uno 108	(266) Une 109	(267) Uun 110								

TRANSITION ELEMENTS

*Lanthanide Series

140.12 Ce 58	140.91 Pr 59	144.24 Nd 60	(145) Pm 61	150.36 Sm 62	151.96 Eu 63	157.25 Gd 64	158.93 Tb 65	162.50 Dy 66	164.93 Ho 67	167.26 Er 68	168.93 Tm 69	173.04 Yb 70	174.97 Lu 71

**Actinide Series

232.04 Th 90	231.04 Pa 91	238.03 U 92	237.05 Np 93	238.03 Pu 94	(243) Am 95	(247) Cm 96	(247) Bk 97	(251) Cf 98	(252) Es 99	(257) Fm 100	(258) Md 101	(259) No 102	(260) Lr 103

( ) indicates the mass number of the isotope with the longest half-life.